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ABSTRACT

This paper reports on an investigation of children's ability to accept contrary-to-fact premises as though they were factual and to reason accordingly. A variety of questions requiring this skill were presented in semi-structured interview form to 10 to 12 subjects from each of six age groups ranging from 5 to 9 years, and to a control group of college-age subjects. Analysis of data from these interviews revealed three main stages in the development of contrary-to-fact reasoning. The first stage, characteristic of 5-year-olds tested, is termed a "strict reality orientation." The second, characteristic of most 6- to 9-year-olds, is termed a "linguistic orientation." The third, characteristic of some 9-year-olds and of the college students, was "true contrary-to-fact reasoning." Results suggest that children in the age range studied tend to solve contrary-to-fact reasoning problems on a verbal rather than logical basis, as might be expected from formal operational thinkers. The inherent logical necessity of a problem had little bearing on the subjects' responses. Subjects in all experimental groups frequently changed initially correct answers in response to mild counter-suggestion and, on other occasions, utilized contrary-to-fact premises when there was no logical necessity to do so. Tentative explanations for differences between responses of different age groups are offered. (Author/BF)

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The Development of Contrary-to-Fact Reasoning

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THE DEVELOPMENT OF CONTRARY-TO-FACT REASONING. Jerome S. Meyer S.U.N.Y. at Geneseo

This study investigates the ability of children from 5 to 9 years old to reason using contrary-to-fact premises. Preliminary findings showed that, contrary to predictions, subjects were able to perform such tasks prior to the onset of formal operations. The present study attempts to define the competencies underlying such performance by using a variety of problems requiring contrary-to-fact reasoning, presented in a semi-structured interview format.

Results suggest that children in the age range studied tend to solve contrary-to-fact reasoning problems on a verbal rather than on a logical basis, as might be expected from formal operational thinkers. Response rationale typically involved literal repetition of the premises with attribution to the experimenter (e.g. "You said that oranges are square, so apples are square too."). Moreover, the inherent logical necessity of a problem had little bearing on the subjects' responses. Subjects frequently (72%) changed initially correct answers in response to mild countersuggestion and, on other occasions (58%), utilized contrary-to-fact premises when there was no logical necessity to do so.

Results also showed that 85% of the 5 year olds were unwilling or unable to respond appropriately to contrary-to-fact problems, but, at the same time, 100% were able to handle a question in the conditional form. This may be due to 5's inability to understand the arbitrary nature of words.

The Development of Contrary-to-Fact Reasoning[1]

The combinatorial system characteristic of formal operational thought theoretically enables the individual to subordinate the realm of the actual to the realm of the possible. Thus an adolescent should be able to accept contrary-to-fact premises as though they were factual and to reason accordingly, whereas a child at a stage before formal operations should not (Elkind, 1974). In preliminary findings by the present author, this hypothesis was not borne out. Children prior to the age of six did typically reject contrary-to-fact statements as premises, but children older than six were generally able to utilize them on some level.

In order to investigate more thoroughly the younger child's ability to perform contrary-to-fact reasoning, a variety of questions requiring this skill were presented in semi-structured interview form to 10-12 subjects from each of 6 age groups ranging from 5 years to 9 years and a group of college aged subjects. Categories of questions included:

1) problems requiring reasoning from contrary-to-fact class properties (e.g. "If oranges were square and peaches were square, what shape would an apple be?")
2) problems requiring reasoning from a contrary-to-fact dichotomous relationship (e.g. "If big were little and little were big, what size would a giant be?")
3) problems requiring reasoning from contrary-to-fact rules (e.g. "If kids went to bed later than grown ups, who would go to bed latest, Billy or his mother?")
4) problems in which the contrary-to-fact statements were not logical

ly connected to the question (e.g. "If strawberries were blue and apples were blue, what color would the grass be?")

5) a question in the conditional form (e.g. "If it were cold today, what would you wear outside?")

Analysis of the data from these interviews revealed three main stages in the development of contrary-to-fact reasoning. The first stage was characteristic of the 5 year-olds tested and might be termed a "strict reality orientation." The second was characteristic of most 6-9 year-olds and might be termed a "linguistic orientation." The third was characteristic of some 9 year-olds and the college students and might be termed "true contrary-to-fact reasoning."

Stage I - Strict Reality Orientation

In this stage the child seems to answer on the basis of the question alone, appearing to disregard the premises. For example

> Randy (5; 11): "If oranges were square and peaches were square, what shape would an apple be? - Round, cause that's what apples spoze t'be. - Could it be any other shape? - No!"

Eighty-two percent of 5 year-olds tested gave similar reality oriented responses to the same question while only twenty-seven percent of 6 year-olds did.

This reality orientation of the younger children was clearly not due to an inability to handle the conditional form since 100% of the 5 year-olds responded appropriately to the question. "If it were cold outside what would you wear?" (The research was carried out during the summer.) It would seem from this that the 5 year-olds are processing the premises and even recognizing their contrary-to-fact nature,

but refuse to draw conclusions based on premises that violate their conception of reality.

The fact that these children were aware of the contrary-to-fact nature of the premises was demonstrated in an interesting fashion by a number of subjects who attempted to utilize the premises and, at the same time maintain their reality orientation. For example,

> Paul (5; 0): "If fat were skinny and skinny were fat, what would tall be? - Tall is skinny because skinny is taller than fat."
> Chris (7; 3): in response to the same question "Skinny, cause when you lose weight you get bigger and bigger."
> (This sounds like someone tried to teach Chris conservation of weight a little too early)
> Jason (5; 5): "If oranges were square and peaches were square what shape would an apple be? - Rectangle - Why? - Lots of oranges are bigger than peaches and apples. An apple would be a rectangle because a rectangle is like a square cut in half."

Stage II - Linguistic Orientation

On the surface it seems as if individuals at this level are responding to the contrary-to-fact nature of the problems by dealing with the premises as though they were real instead of dealing with the questions as if they were detached from the premises, as did the 5's. In other words, they do give contrary-to-fact responses. However, if one looks at the explanations given it is clear that many of these individuals seem to be subject to a tendency to use exclusively linguistic information to solve the problems, a tendency which might be termed "literalism." For example, many explanations for responses at this level involved partial or full restatement of the premises (e.g. 84% in the case of the question, "If big were little and little were big what size would a giant be"). Also prevalent were responses which might be classified as linguistic-perseverative. For example,

Jill (6; 6): "If oranges were square and peaches were square what shape would an apple be? - Square. - Why? Cause everything else is square.")

Further evidence of "literalism" may be seen in the fact that 30% of all subjects in the 6-8 range gave at least one explanation referring to the experimenter's verbal assertions as justifications. For example

Martha (7; 5): "If kids went to bed later than grown-ups who would go to bed later, Billy or his mother? - His mother because little kids, you said, went later than the mother."

The general feeling that I got testing some of these children was one of defiance. It was as if they were thinking "I can solve your silly word games if you want me to, but you're not going to get me to believe any of it."

Another thing that led to the belief that children at this age were not engaging in true contrary-to-fact reasoning was their inability to distinguish between situations in which contrary-to-fact responses were necessary and those in which they were not. For example, in the question "If big were little and little were big, what size would a giant be?", "little" is a logically necessary response. However, 62.5% of the 5-9 year olds tested (0% of the college-aged sample) changed their initially correct answers when given extremely mild countersuggestion. In contrast, there is no logically necessary response to the question, "If strawberries were blue and apples were blue what color would the grass be?", but 57.5% of the 6-9's (0% of the college-aged sample) gave blue as a response.

Before discussing stage 3 some speculation may be in order regarding the reasons why 5 year-olds are not willing and/or able to give

contrary-to-fact responses whereas children older than 6 are. The answer to this question may lie in the nature of the child's developing symbol system. Specifically, it has been suggested by Piaget (1929) and Werner and Kaplan (1963) among others that the young child may be subject to a phenomenon called "word realism" wherein the symbol is indifferentiated from its referent. In other words, for the preschooler the word would be inextricably bound to the object or event it represents.

According to this position it would make sense that the preschool child would be hesitant to verbalize a contrary-to-fact statement. It would, in sense, be tantamount to an actual transformation of reality. The older child, who has developed the ability to differentiate subject from object, is able to understand the arbitrary/symbolic nature of words. This understanding permits children to make the type of literal response which was characteristic of most school age subjects in this study.(i.e. to play the game without offending their sense of reality).

The preschoolers in the present study, however, emphatically maintained their reality oriented responses (e.g. "apples have to be round") indicating that they were unwilling to enunciate a contrary-to-fact premise even though they seemed to have some conception of the answer the experimenter "wanted".

Another interesting finding which may reflect the effects of word realism comes from the present data on contrary-to-fact reasoning using social rules. With social rules, a great deal of pressure is placed on the young child to view the word as having an irrefutable

relation to reality. If a parent states a rule, he or she does not want the child to play word games with that rule. Such pressure to view spoken rules as immutable may result in a type of artificially induced word realism. Specifically, in the present study if such an effect were in operation one might expect an extension of the stage of "strict reality orientation" with problems involving social rules. This seems to be the case. For example, in response to the question, "If kids went to bed later than grown ups who would go to bed later, Billy or his mom?", 64% of the 6 year-olds gave reality oriented responses. In contrast, when dealing with contrary to fact properties of the physical world, only 27% of the 6 year-olds gave reality oriented responses.

Stage III - True Contrary-to-Fact Reasoning

This stage can be characterized in two ways. First, the individual is able to perceive the logical necessity inherent in a contrary-to-fact problem and to reason accordingly. However, this is not surprising since awareness of logical necessity has been studied in the context of formal operational thought in general and may bear little relevance to contrary-to-fact reasoning per se.

Second, the stage III reasoner seems, for the first time, to be genuinely capable of extending the implications of contrary-to-fact premises. One indication of this is the fact that many of the 9 year-olds and all of the college sample utilized class properties to justify their contrary-to-fact responses. Another indication of ability to extend implications comes from the data on problems in which the premises were unrelated to the questions (e.g. "If strawberries were

blue and apples were blue, what color would grass be?"). With this sort of problem a percentage of subjects at each age level gave responses which did not jibe with either the typical reality oriented response (e.g. "green") or the typical literal response (e.g. "blue"). At the youngest age levels such additional responses were fantasy oriented (e.g. "Purple ... 'Cause that's another color I like.") For subjects at the intermediate age levels a typical response was, "Red ...Because it's the opposite"(meaning "the strawberries were red and are now different so the grass should be the color that the strawberries were"). This would seem to be another type of linguistic/perseverative response based on the notion of opposites presented in previous contrary-to-fact premises, but inappropriate here. The college-aged subjects also gave responses other than "blue" or "green". However, they seemed to be of a qualitatively different type than those of the younger subjects in that they seemed to make an attempt to imagine a world in which strawberries and apples would actually be blue. For example,

> Chris (18; 7): "Yellow. My idea is that red is the opposite of green (on the spectrum) and blue is the opposite of yellow."

The evidence for this third s age as distinct from the previous stage is admittedly thin. Consequently, as an indicator of formal operational thought, The present instrument is something of a failure. However, the results of the study as a whole do seem to tell us something about how individuals of different ages may deal with information which contradicts their notions of reality.

Footnotes

[1]Thanks are due to David Elkind for providing the original idea upon which the present research is based and to Holly Hills for aiding in the collection of data.

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Piaget, J. The Child's Conception of the World. New York: Harcourt Brace and Company, 1929.

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"If oranges were square and peaches were square what shape would an apple be?"

	square	round
5	1	9
6	7	3
7	7	1
8	8	1
9	7	1

$\chi^2 = 22.61$, $p<.001$

"If big were little and little were big what size would a giant be?"

	big	little
5	7	3
6	3	7
7	2	8
8	0	10
9	1	9

$\chi^2 = 10.23$, $p<.05$

"If kids went to bed later than grownups who would go to bed latest, Billy or his mother?"

	Billy	Mother
5	7	4
6	7	4
7	3	7
8	6	4
9	1	9

$\chi^2 = 9.78$, $p<.05$

"If strawberries were blue and apples were blue what color would the grass be?"

	Green	Blue	Other
5	6	2	3
6	3	6	2
7	2	4	4
8	0	7	3
9	1	6	3
College	9	0	3

$\chi^2 = 24.91$, $p<.01$

Figure 1. Frequency of responses to representative contrary-to-fact questions by age group